THE SOUND OF OUR WORDS: SINGLING, A TEXTUAL SONIFICATION SOFTWARE

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ABSTRACT

As visualization struggles to grasp the intricate and temporal networks of meaning found in textual data, sonification emerges as a creative and effective way of representing language. Accordingly, this paper seeks to introduce Singling, a textual sonification software that allows users to create and manipulate auditory representations of a text's lexicogrammatical properties. To achieve this, we first present Singling's main features and interface. We then discuss an example of using this sonification software to explore—both analytically and aesthetically—three different poems. Overall, this paper seeks to introduce researchers, educators, and artists to the many possibilities of Singling and the practice of textual sonification, which includes data analysis, multimodal and collaborative narrative creation, and musical performance to name a few.

1. INTRODUCTION

Over the last few decades, several scholars [1]–[3] have emphasized sonification as a way to better represent and analyze different facets of data—facets that are nowadays limited to the possibilities of visualization, the 'representational force' of modern societies [4]. Indeed, Lodha, Wilson and Sheehan outline some aspects where sonification can outperform visualization: "Sonification can often provide information about data that cannot be seen using visualization. Sound can enhance a graphical presentation by providing information about features of the data that may be hidden or occluded. Sound can also help the user to distinguish the size relationships between objects that may be difficult to determine visually because of projection distortion." [5, p. 3].

Furthermore, one specific field where sonification can prove fruitful—one that has not been widely explored in the past and where all the limitations of visualization are exacerbated—is in textual representation. Certainly, visualization of textual data has been deemed to "freeze the world" [6], as it erases much of its temporal context. Since textual sonification is essentially about re-rendering linguistic data as acoustic vibrations and re-mapping them onto the canvas of temporality, it has a great potential for opening up a new avenue for meaning-making that resists temporal fixation. Hoping to explore the potential of textual sonification, we at the Digital Literacy Centre (DLC) at the University of British Columbia have developed Singling.

Singling is a software that affords the creation and manipulation of auditory representations of a text's lexicogrammatical properties. Singling was developed with the main purpose of exploring literacoustics: the act of reading a text by listening to its sonification [7]. Indeed, we position literacoustics as a new way of apprehending meaning in texts—a way that escapes an over-reliance on visual displays of information and invites an aesthetic, temporal, and visceral reading of language. Nevertheless, our explorations of Singling have shown many other venues of creative and analytical use of this software. To just mention a few, we have used Singling to create collaborative stories [8], musical experimentation [9], and multimodal data analysis [10]. As our exploration of Singling continues to evolve and forges connections with new collaborators and users, we hope to expand on the possibilities of this textual sonification platform.

Accordingly, this paper aims to describe Singling by outlining its technical capabilities and some of its uses and possibilities. To achieve this, we will first describe Singling's interface,

showing some of its features and limitations. Then, we will discuss an example of how we are using Singling at the DLC, discussing the exploration of three poems by sonifying some of their textual features. Finally, we outline some of the future directions of Singling, emphasizing different ways in which researchers, educators, and artists (to name just a few) could make use of this sonification software.

2. SINGLING

Singling is an open-source software for the sonification of linguistic data. As we started to create this software, we were looking to create an interface where users could transmediate textual data into sound by adding and manipulating personalizable sets of systematic transformations. To achieve this, we relied on JFugue, an open-source library focused on programming music in Java. With JFugue as a starting point, Singling's first iterations were based solely on the sonification of individual alphabetic characters as we built upon an existing program that helped us to engage in basic textual sonifications [11]. As we continue to discover its aesthetic and analytical potential, we have added features progressively, and Singling can now not only process words, but can also differentiate word types (such as nouns, verbs, and adjectives), special characters (such as capitalized letters and punctuation), and lexicogrammatical categories (such as nouns denoting animals, or verbs denoting feeling) to name a few. Such a nuanced approach towards textual data was achieved by first integrating Wordnet [12], an extensive lexical database of the English language, and was further improved by creating other complementary databases, such as pronouns and prepositions, that were not included in the original catalogues. To better describe Singling's current affordances and processes, in the following paragraphs its interface (Figure 1) will be described.

On the left of the interface, users can set default parameters for the textual sonification. This set of default parameters includes instruments (with 128 different MIDI instruments), note durations (from a whole note to a one-hundred-and-twenty-eighth-note), octave range (from 0 to 10), tempo (from 0 to 250 beats per minute), fundamental frequency (from A0 to C8), rest duration (for both spaces between words and line breaks),

scope (either word or character level), note behaviour (either following the overtone series, as a static note or mute), stream mode, and sentiment analysis. By engaging with these different parameters, users are able to set the basic systematic transformations that will sonify the input text.

On the right side of the interface, users can further complexify their sonifications of textual data by selecting specific triggers that lead to specific transformations in the output. Even as these transformations are cumulative—adding different sound transformations within the same sonification—inputs with the same parameters cannot be entered more than once (e.g., you cannot make verbs trigger the volume to increase and decrease at the same time). Triggers for these transformations include word types, lexicogrammatical categories, word length, symbols, punctuation, and characters. Each transformation is determined by either a set value or an increment in a range of sonic features, such as tempo, attack, decay, instrument, pan, and pitch bend, to name a few. For example, users can transform verbs to be played at a higher octave range than the rest of the sonification. In this instance, notes triggered by verbs are transposed by the specified number of octaves above the fundamental frequency and the upper limit of the transposition is determined by the waveform characteristics of the specific instrument. When octave range is lowered, notes above the set octave range are transposed down. Additionally, the feature Lexicon allows users to preselect specific words or a sentence that will generate a specific sound, so that users can easily identify those terms when listening to their sonification.

Finally, in the middle section of Singling's interface, users can input their literal text and play the sonification with all the previously set parameters and transformations. When the sonification is set to work at the word level, Singling will highlight each word as it is sonified by the software. In this section of Singling's interface, users can export their sonification as both a WAV file or as a MIDI file—thus making it possible to either play their outputs on any music player on their computer or continue a sonic transformation by importing the file in a MIDI sequencer. Additionally, it is possible to save any set of default parameters, texts, and transformations in a Java .txt file so they can later be opened again on Singling or shared with others.
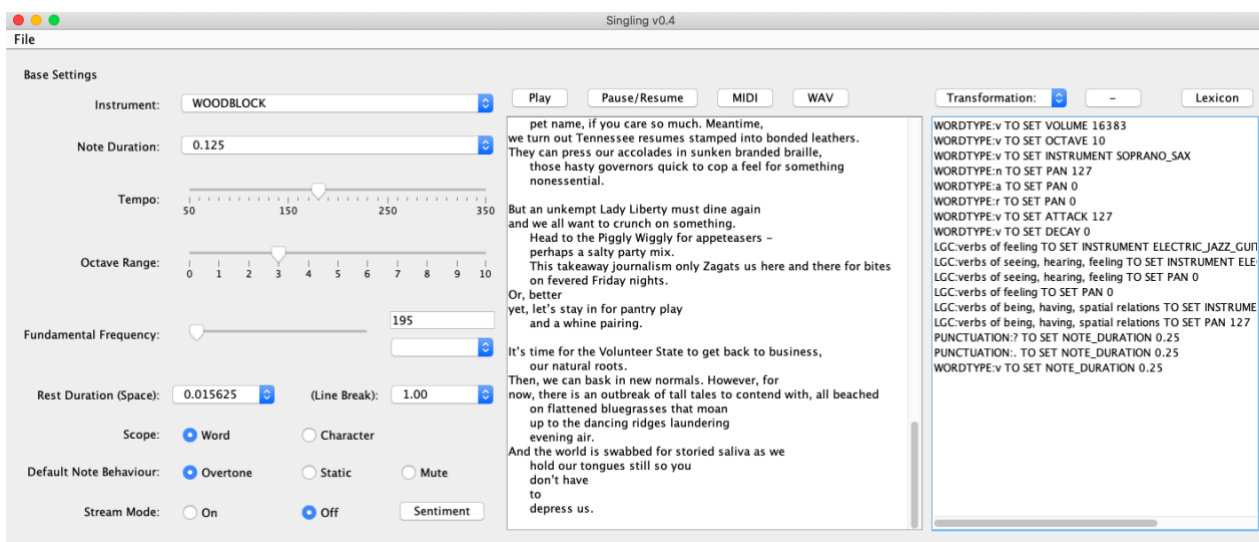

Figure 1: Singling's interface

While Singling is still under development and we continue to add new features periodically, users can download the latest version [13]. In the next section, we will further show how Singling works by describing a case study that examines the use of this textual sonification platform to analyze three poems.

3. LET SINGLING SING: AN EXAMPLE OF POEM SONIFICATIONS

To better exemplify Singling's affordances, in this section we will describe the process of sonifying three poems with the software. To achieve this, we draw on poems available at PhoneMe [14], a platform developed by the DLC that allows users to create, record, share their poems and geotag them on an interactive map. More specifically, we relied on the following poems: 1) Water, by Vi; 2) We Volunteer as Tribute: A Quarantine Poem, by Amber Moore; and 3) Catch Me, Outside, by Lyre. These poems—available to read and listen online [15]-[17]—were created amid the COVID-19 pandemic and reflect the poets' different lived experiences and perspectives of this global event. These varied poetic explorations provide a fertile ground to explore Singling's many capacities for sonifying textual data.

In order to explore the range of Singling's possibilities, four members of the DLC created a unique set of parameters and transformations that responded to different aesthetic or analytical goals. Although all sonifications are available online [18], in this paper we will specifically explore the sonification produced by one of the DLC members (EM). EM created a set of transformations that aimed to explore the differences in both the prevalence and use of verbs across all three poems. To achieve this, he first set the predetermined instrument to be woodblocks, and then created a specific transformation to set all verbs to be played by a soprano saxophone, thus highlighting them over all other word types. To further emphasize this specific word type, the octave range, volume, and the attack of these verbs was raised to the maximum, and their decay lowered to the minimum possible value.

Moreover, looking to improve the analytical scope of the sonification, EM aimed to differentiate between verbs that indicated the lexicogrammatical category of being or feeling, since these verbs were widely used in all three poems. To do this, he set the verbs that indicated being to be panned to the left and the verbs that indicated feeling to be panned to the right. However, it is important to note that—as words often have multiple LGCs (e.g., hearing is played as a verb of perception and a noun of acts)—the final sound at any given moment is not likely to be panned entirely to any side, but rather it will be skewed towards the right or the left. Additionally, he assigned both lexicogrammatical categories to be played with an electric guitar to further emphasize their differentiation from words of other lexicogrammatical categories. EM also added the words "I", "I'd" and "I'm" to the lexicon option of Singling, looking to identify when the authors of the poems were talking about themselves in their writing. Finally, EM added additional transformations to either ease the literacoustic reading of the poems or to make the sonification more aesthetically pleasing. For example, he included a transformation to pan to the left all adjectives and adverbs, and another transformation to pan to the right all the nouns, thus creating a more complex percussive background. Additionally, EM made the note durations for commas and periods longer—from the predetermined eight-note to a

quarter-note— thus making it easier to listen and follow along with the sonification of the written poem. The final sonification of all three poems, as well as a screenshot of the transformations and parameters set on Singling, are available online [19].

Auditing the three poems as sonified by this set of transformations, it is possible to identify specific features in both their content and structure. For example, in the poem Water, it is possible to identify that—although it relies less on verbs than the other two poems—the verbs used are frequently panned to the right, thus indicating a predominance of verbs that indicate feeling. Additionally, the sonification demonstrates that the poem lines are short, providing brief melodic pieces. These features are better exemplified by the final four lines of the poem:

> *My solitude*
>
> *To my dream*
>
> *To my love*
>
> *Water*

In the second poem, written by Lyre, the sonification evidences longer lines, resulting in more complex melodic lines. Additionally, this poem features the sound of a timbal (the sound produced by Singling when the words inputted in Lexicon are played), thus highlighting the common use of the first-person singular pronouns in its lines. Moreover, Catch Me, Outside displays a large number of verbs, as demonstrated in the lines:

> *This may not sound so heartfelt*
>
> *but what do you do for yourself*
>
> *when you can't make sense of the cards you were dealt*
>
> *run? hide? do you lie to yourself?*

Finally, in the poem We Volunteer as Tribute: A Quarantine Poem, it is possible to identify that it frequently uses verbs of being and feeling, constantly generating sounds panned to both the right and left in the sonification. Moreover, the most predominant characteristic of this poem's sonification with these Singling transformations is its structure, as it provides a complex rhythm that does not seem to follow repetitive patterns—thus suggesting divergence from common line patterns in poems, as represented visually in the following lines:

> *And the world is swabbed for storied saliva as we*
>
> *hold our tongues still so you*
>
> *don't have*
>
> *to*
>
> *depress us.*

Furthermore, the sonification process of this last poem highlights the limitations of computational approaches to language. In this sense, an analytical listening to Amber

Moore's poem shows how Singling fails to distinguish between words that could represent either a noun or a verb—a limitation also evidenced in the previously discussed poem Water. For example, in the line "Lean in and call me by my pet name," the words "pet" and "name" could be read either as verbs and nouns—and accordingly, Singling plays those words as both nouns and verbs—which constrains the analytical exactitude of this approach to language representation. These limitations are not new, nor are they exclusive to Singling, as they are common constraints that the development of natural language processing has had to deal with over time. Nevertheless, as Singling's main objective is not to replace nor emulate visual approaches to data representation, we embrace these spaces of ambiguity by opening a more aesthetic, visceral reading of the text [20], thus refusing to freeze both the word and the world.

Accordingly, after discussing Singling's analytical affordances and limitations, we now move to briefly explore some of its aesthetic possibilities. EM played the sonification of each of the three poems to the other DLC members without explaining either his goal or the set of parameters and transformations that composed the sonification process. Each DLC member was then tasked to write a set of keywords or phrases that metaphorically described their perception of each of the sonic compositions. Descriptions that each member of the DLC provided were not shared until all the poems were played and were then read and discussed by the whole group. This activity was undertaken to explore a visceral—beyond the analytical—listening of the three poems' sonification, thus exploring the aesthetic features and potential readings.

Outcomes of the sonified poetry's aesthetic exploration further show Singling's affordances to analyze data and foster collaborative creative scenarios. For example, in the poem We Volunteer as Tribute: A Quarantine Poem, listener descriptions of their visceral responses included "timidity and sudden disclosures" and "forward movement and interruption" (RH), or "adventurous" and "night in the jungle" (KJ). In the poem Catch Me, Outside, listeners identified the sonification as either "confrontational" and "busy" (EY) or as "serious" and "business-like" (KJ). Finally, in the poem Water, responses included descriptions such as "polyphonic cry" and "softly warm" (YT), or "peoples footsteps hurrying to board the train" (EY). These responses indicate that there is not one static reading of each poem's sonification, but instead suggest that users and researchers approach the act of listening from varied interpretative paths that challenge notions of positionality, modality, and authorship, among others. Indeed, these aesthetic/visceral readings provide new avenues of inquiry and creation for artists, educators, and researchers that could position them to better understand listeners' subjectivity when interacting with sonification and other auditory displays. Such possibilities, to just mention a few, include the analysis of the aesthetic responses by using sentiment analysis, enriching the sonic creations by sonifying participants' descriptors, or taking their responses as creative cues to write poetry.

4. CONCLUSION

As exemplified by the previous description of the program and a sample of its many uses, Singling affords users an innovative approach to the sonification of textual data based on a lexicogrammatical mapping of language and a rich set of sonic transformations and presets. Indeed, even as Singling is limited in the same ways as other sonifications are—such as in the imprecision of audition compared to visualization or the widespread individual differences in sonic perception [21]—we believe that this program offers many possibilities for people interested in sonification to expand the creative and critical reach of the field further. Accordingly, while we at the DLC are in the continuous process of exploring Singling's affordances, it is clear that the program offers particular benefits for artists, educators, and researchers interested in exploring data analytically and/or aesthetically. We then extend an invitation to artists, researchers, and educators to engage with Singling and explore its potential in different domains and contexts. These explorations—which assist us to evaluate Singling and to improve its usability—could include integration with visual arts [22], engagements in multimodal data analysis [23], support for people with visual disabilities [24], or the creation of music from social commentary [25].

Alongside this exploration of the program, we continue to develop Singling by integrating new features. For example, we are currently exploring the integration of natural language processing into Singling's next version by connecting to the application program interfaces of Stanford CoreNLP [26] and Wordnet [12]. This integration will allow Singling, among other things, to disambiguate words based on their proximity to other words and to associate sentiment analysis values to the sonification of textual data. As we continue to improve Singling, we expect to open this music box of textual sonification to others who wish to listen to the words without freezing the world to the many meanings and nuances of words.

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